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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B02C 4/08, 4/28, 18/14, 18/16	A1	(11) International Publication Number: **WO 00/35585** (43) International Publication Date: 22 June 2000 (22.06.00)

(21) International Application Number: PCT/GB99/04216

(22) International Filing Date: 13 December 1999 (13.12.99)

(30) Priority Data:
9827573.8 15 December 1998 (15.12.98) GB

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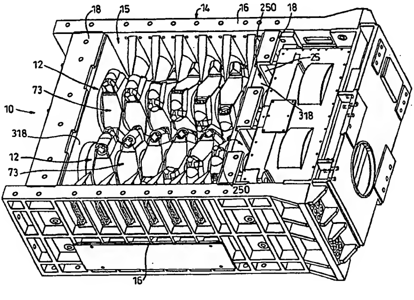
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: A MINERAL BREAKER



(57) Abstract

A mineral breaker including a pair of opposed end walls (18) and a pair of opposed side walls (16) which define a passageway for material to be broken, the opposed end walls (18) and side walls (16) being fixedly secured to one another to form a unitary housing, at least one rotatable breaker drum assembly (12) extending across the passageway and being rotatably supported in said opposed end walls (18), said opposed end walls (18) each having an elongate open mouthed slot (250) for enabling insertion/removal of said drum assembly into/out of said unitary housing.

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A MINERAL BREAKER

The present invention relates to a mineral breaker.

In particular the invention relates to a mineral breaker of the type which utilises a rotatable breaker drum mounted in a housing for breaking lumps of mineral into smaller pieces.

The breaker drum may be of the crusher type which operates to break down mineral by a crushing action or may be of the type which operates to break down mineral by a snapping action, ie. apply tensile loadings to cause the mineral to snap.

With the first mentioned type, the drum tends to be of a large diameter relative to the maximum size of lump to be broken and has breaker teeth which are relatively small.

With the second type, the drum tends to have large teeth relative to the diameter of the drum. Examples of this second type of mineral breaker are described in our European patent 0096706.

In particular, but not exclusively, the preferred embodiment of the present invention is concerned with a mineral breaker of the second type having a pair of side by side breaker drums rotatably mounted in a housing.

According to one aspect of the present invention there is provided a mineral breaker including a pair of opposed end walls and a pair of opposed side walls which define a passageway for material to be broken, the opposed end walls and side walls being fixedly secured to one another

to form a unitary housing, at least one rotatable breaker drum assembly extending across the passageway and being rotatably supported in said opposed end walls, said opposed end walls each having an elongate open mouthed slot for enabling insertion/removal of said drum assembly into/out of said unitary housing.

According to another aspect of the present invention, there is provided a mineral breaker including a pair of opposed end walls and a pair of opposed side walls which define a passageway for material to be broken, at least one rotatable breaker drum assembly extending across the passageway and being rotatably supported in said opposed end walls, each end wall comprising a cavity wall structure having an inner wall defining a side to said passageway, an outer wall and at least one material discharge cavity located therebetween a bearing housing for the breaker drum assembly being mounted on the outer wall so as to be spaced from the inner wall such that material passing through the inner wall towards the outer wall is able to discharge through said discharge cavity before reaching said bearing housing.

Preferably the inner and outer walls are integrally joined together. Preferably the inner and outer walls are integrally joined together by a series of web members.

Preferably the side walls and end walls are fabricated from steel plate. The side walls and end walls may be secured to one another by fixing means, such as bolts, or alternatively may be integrally connected, for example by welding.

Preferably the bearing housing at each end of the breaker drum assembly is mounted in a support body, the support body being fixedly secured to the respective end wall.

Preferably the outer wall of each end wall has an open mouthed slot into which said support body is slidably located prior to fixing. Preferably the open mouth of the slot is located on the top side of the end wall to enable the drum assembly to be lowered into the housing for fixing.

Preferably the drum assembly includes a shaft having a first bearing mounted adjacent one end and a second bearing mounted adjacent its other end, one of said bearings being axially fixedly mounted on the shaft and axially fixed mounted within its bearing housing to thereby act to restrain axial movement of said shaft.

Preferably the mineral breaker includes a pair of breaker drum assemblies located side by side to define therebetween a gap through which material to be broken is forced by said drums, and a breaker bar assembly mounted on said opposed end walls so as to extend parallel to and below said gap, the breaker bar co-operating with said breaker drum assemblies to further break down material passing through said gap.

Various aspects of the present invention are hereinafter described, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a mineral breaker according to an embodiment of the present invention;

Figure 2 is a CAD drawing showing, in perspective, the mineral breaker of Figure 1 during assembly;

Figure 3 is a CAD drawing showing in plan the mineral breaker of Figure 1 during a later stage of assembly;

Figure 4 is a part sectional plan view of the mineral breaker shown in Figure 1 and a gear box attached thereto;

Figure 5 is a plan view of the housing of the mineral breaker shown in Figure 1;

Figure 6 is a sectional view taken along line VI-VI in Figure 5;

Figure 7 is an end view of the housing shown in Figure 5;

Figure 8 is a side view of the housing shown in Figure 5;

Figure 9 is a CAD drawing showing, in perspective, the housing of Figure 5;

Figure 10 is an axial section along a breaker drum assembly of the mineral breaker shown in Figure 1;

Figure 11 is an end view (as viewed in direction of arrow XI) of the drum assembly of Figure 10;

Figure 12 is an end view of a breaker tooth ring assembly shown in Figure 10;

Figure 13 is a part view similar to Figure 6 showing a breaker bar assembly mounted on opposed end walls;

Figure 14 is a plan view of the breaker bar assembly shown in Figure 13;

Figure 15 is an end view of the breaker bar assembly shown in Figure 13;

Figure 16 is a sectional view taken along line XVI-XVI in Figure 14;

Figure 17 is a side view of a tooth for the breaker bar assembly;

Figure 18 is a rear end view of the tooth shown in Figure 17;

Figure 19 is an end view, partly in section, of a mineral breaker of Figure 1 showing the position of the breaker bar assembly relative to the breaker drum assemblies;

Figure 20 is a view similar to Figure 5 showing an alternative construction of the unitary housing; and

Figure 21 is a side view of the housing shown in Figure 20.

A mineral breaker 10 according to a preferred embodiment of the present invention as illustrated in Figure 1.

The breaker 10 includes a pair of breaker drum assemblies 12 located side by side in a housing 14.

As seen more clearly in Figures 2, 5 and 9 the housing 14 includes a pair of opposed side walls 16 and a pair of opposed end walls 18, the inner sides of which define a passageway 15 through which material to be broken is guided.

The side walls 16 and end walls 18 are secured to one another to thereby define a rigid unitary housing which is of an open box-like structure (see in particular Figures 2 and 9) which serves to accommodate working loadings experienced by the drum assemblies 12 during use.

In this respect, the side walls 16 and end walls 18 may be fixedly secured to one another by bolts (as exemplified in Figures 2 and 5) or by welded joints (as exemplified in Figures 20, 21).

Preferably as shown, the end walls 18 are located internally inbetween the opposed side walls 16 such that the end faces, defined by end plates 18a

(Figure 5), of the end walls 18 abut against the inside face, defined by side plate 16a (Figure 5), of the adjacent side wall 16.

With such an arrangement it is possible to use the same size of end wall 18 in combination with different lengths of side walls 16 so as to provide mineral breakers 10 having different capacities.

Each end wall 18 is constructed so as to rotatably mount one end of each drum assembly 12.

Each end wall 18 is constructed so as to define a cavity wall structure having an inner wall 25 and an outer wall 26 with cavities 28 located therebetween. Preferably the end wall 18 is a unitary structure so as to act as a single component for forming the rigid box structure referred to above.

As seen more clearly in Figures 3, 4 and 5, the cavities 28 are preferably arranged to extend to the lower edge 18b of the end wall 18 so as to provide a discharge path for dirt and other fine particulate material and preferably also extend to the upper edge 18a so as to provide open access to the cavity from above.

A bearing housing 50 of each drum assembly 12 is mounted on the outer wall 26 so as to be spaced from the inner wall 25, the shaft 51 of the drum assembly 12 extending across a cavity 28.

Since the shaft 51 passes through the inner wall 25 it is possible that dirt and other fine particulate material may pass through gaps inbetween the shaft 51 and inner wall 25. However, any such material on passing by

inner wall 25 will enter cavity 28 and will therefore fall through the cavity 28 to be discharged beneath the end wall 18.

Should the material be sticky it will tend to build up upon the shaft 51 and possibly block the cavity 28. Such material can easily be washed away or removed using a high pressure water jet or air jet.

Accordingly, dirt and other fine particulate material is discouraged from reaching the bearing housing and so reduces the likelihood of bearing failure due to dirt entering the bearing and causing wear/seizure.

Preferably as particularly illustrated in Figure 10, each drum assembly 12 is assembled prior to insertion into the breaker housing; the assembly 12 including a pair of bearing housings 50 located at opposite ends of the shaft 51.

Preferably the shaft 57 of each drum assembly 12 includes a shaft 51 which is stepped and has a central portion 53 on which a group of breaker teeth ring assemblies 60 are mounted. In the illustrated embodiment, each breaker teeth ring assembly 60 includes a generally annular body 61 on which three breaker teeth 70 are mounted.

The ring assemblies 60 are mounted side by side in abutment with one another and are held in abutment, and prevented from moving axially along the shaft 51 by a pair of stop collars 63, 64. Preferably both stop collars 63, 63 are screw threadedly received on the shaft 51. Each ring assembly 60 is keyed onto shaft portion 53 in order both to prevent rotating on the shaft 51 and to set its rotary position relative to the shaft 51. In this respect, neighbouring ring assemblies 60 are preferably set at

different rotary positions relative to the shaft 51 so as to stagger the teeth 70 on adjacent ring assemblies 60 and thereby define discrete helically extending deep troughs 73 (see Figures 1, 2 and 3) extending along each drum assembly 12.

The number of teeth 70 on each ring may be more than 3; for example any of the breaker teeth ring assemblies described in our GB patent 2170424 and European patents 0096706 and 0114725 may be incorporated into housing 14.

Each bearing housing 50 houses a bearing assembly 511 having an inner race 53 mounted on the shaft 51 and outer race 54 received in housing 50. Preferably each bearing assembly 511 is of the type intended to prevent axial displacement between the inner and outer races 53, 54.

Each housing 50 includes a mounting support body 57 having a bore 58 in which the outer race 54 of the bearing assembly 51 is seated. Each end of the bore 58 is closed by an end plate 59 bolted to the support body 57.

A seal support ring 150 is seated on the shaft 51 adjacent each end plate 59 and a shaft seal 151 is provided between each end plate 59 and support ring 150. Preferably the support ring 150 located on the inner side of the bearing housing 50 includes an annular flange 152 which together with the adjacent end plate 59 defines a labyrinth passageway 153 for deterring passage of dirt and other fine material to the interior of the housing 50. Preferably a lip seal 154 is located inbetween the labyrinth passageway 153 and the shaft seal 151.

The breaker drum assembly 12 preferably further includes a spacer ring 160 seated on the shaft 51 inbetween support ring 150 and the adjacent stop collar 63 or 64.

An additional pair of stop collars 165 are screw threadedly received on the shaft 51 and on tightening serve to co-operate with the adjacent stop collar 63 or 64 to retain the inner race 53 at an axially fixed position by virtue of axial abutment with rings 150 and 160.

The support ring 150 projects axially beyond the outer face of the outer end plate 59 such that after tightening, stop collar 165 is spaced from the outer end plate 59 and so does not impede rotation.

At one end, the shaft 51 has a ring gear 96 mounted thereon. Ring gear 96 is fixedly mounted for rotation with the shaft 51, preferably by splines.

The ring gears 96 of adjacent drum assemblies mesh with one another and serve to transmit rotary drive from one shaft to the other and also maintain synchronism between the rotary position of the shafts.

Only one of the shafts 51 is driven by an external motor (not shown) via a gear box 170. The gear box 170 has an output shaft 171 which is drivingly connected to the shaft 51 of one of the drum assemblies via a drive coupling 172.

One half 173 of the drive coupling 172 is axially retained on the shaft 171 by an end plate 120 which is fixed in face to face abutment with the axial end face of shaft 51 by bolts 121. Plate 120, via spacer rings 130 and coupling half 173 retains the ring gear 96 at a fixed axial position.

The ring gear 96 on the shaft 51 of the other drum assembly which is not directly connected to the gear box 170 is axially held in place by a plate 120 which abuts against spacer ring 125.

Preferably the bearing housing support body 57 is slidably located in a slot 250 formed in the end wall 18.

Preferably as seen, the slot 250 is open topped such that the drum assembly 12 may be lowered into the housing until the support body 57 is seated in position. In this respect, support body 57 is preferably provided with a horizontal support flange 57a which seats upon a horizontal flange 28a formed on each end wall 18.

The support body 57 is thereafter secured to the end wall by bolts 157. Prior to insertion of the drum assembly, the distance between support bodies 57 at opposite ends of the drum assembly is slightly greater than the distance between the outer faces of the end walls 18 to thereby enable the drum assembly to easily slide along slots 250 into position. On tightening of bolts 157, the support bodies 57 and opposed outer faces of the end walls are brought into face to face abutment, the clearance gap therebetween being accommodated by the outer race of at least one of the bearing assemblies sliding axially within its housing. Bolts 257 are preferably used to secure flanges 57a and 28a together.

Preferably an inner shield plate 318 is located in face to face contact with the inner face of inner wall 25 in order to close off the slots 250 from passageway 15.

Preferably in order to isolate end plate 120 and bolts 121 from axial shock loadings caused during breaking of mineral by the drive assemblies, the outer face of one of the bearing assemblies, preferably the bearing assembly adjacent to ring gear 96, is axially restrained within its bearing housing, preferably by packing 260 (Figure 10).

Accordingly the bearing assembly acts to prevent axial movement of the shaft 51 since its inner race is axially fixed between stop collars 64, 165 and its outer race is axially fixed to the plate 57 via end plates 59 and packing 260.

As indicated above, the ring gears 96 act to synchronise the relative rotational positions by drum assemblies. The synchronism may be conveniently adjusted by raising one of the drum assemblies out of its slot 250 to disengage the ring gears 96 (see Figure 2), rotating it by a desired number of gear teeth spacings on the ring gear and lowering it back into the housing. This process of adjusting the synchronism is convenient to perform as it does not involve disassembly of the drum assembly and can be performed on site using simple lifting tackle.

As indicated above, the side walls 16 and end walls 18 may be fixedly secured together to define a unitary housing by the use of bolts or by welding.

Preferably, if the side walls 16 and end walls 18 are to be joined by welding, the arrangement illustrated in Figures 20, 21 is adopted.

In this arrangement, end plates 18a are dispensed with. Instead, the side plate 16a of each side wall 16 is provided with apertures 16b through

which tongues 18b formed on walls 25, 26 project. The tongues 18b and plates 16a surrounding apertures 16b are welded together.

As seen in Figures 13 to 19, the mineral breaker preferably includes a breaker bar assembly 300.

The assembly 300 includes an elongate support body 301 which is mounted at each end on opposed end walls.

As seen in Figure 19, the support body 301 is located beneath the gap 302 inbetween the drum assemblies 12 such that mineral passing through the gap 302 falls onto the breaker bar assembly 300.

The breaker bar assembly 300 includes two series of breaker teeth 306, 307 located on opposite sides of the body 301 and which co-operate with teeth on the breaker drum assemblies 12 in order to further break down lumps of mineral passing through gap 302.

Preferably, the support body 301 is provided at each end with a mounting plate 308 having an overall width W.

The inner wall of each end wall 18 is provided with an inwardly directed support flange 310 upon which a respective mounting plate 308 is seated in use.

Preferably each mounting plate 308 is fixedly attached to a respective support flange 310 by bolts (not shown).

Preferably the gap 312 inbetween at least one end of each support flange 310 and the opposed side wall has a length D which is greater than distance W to thereby enable the breaker bar assembly 300 to be easily removed. This may be done by removal of bolts securing the mounting plates 308 to the respectively support flanges 310 and then sliding the breaker bar body 301 in a lateral direction until mounting plates 308 are able to drop through gaps 312 and thereby enable the breaker bar assembly 300 to be removed from beneath the mineral breaker.

Preferably the gap 312 on both sides of each support flange 310 is the same and of a dimension D such that the breaker bar assembly may be removed from either side of the support flange 310.

Preferably the support body 301 includes a main central support beam 340 having on its upper face an open topped channel 330 extending longitudinally along its length.

The channel 330 has a series of bolt holes 332 passing through the bottom 333 of the channel, the bolt holes 332 being regularly spaced along the channel 330.

The breaker teeth 306, 307 each have a tooth body 350 which is seated upon the upper face 342 of beam 340, the tooth body 350 having a downwardly directed lug 345 which is seated within the channel 330. A bolt hole 353 passes through the tooth body 350 and in use a bolt (not shown) is located within bolt hole 353 and an aligned bolt hole 332 in order to fixedly retain the tooth body 350 in position. Preferably the head of the bolt and bolt hole 353 co-operate to prevent rotation of the bolt during tightening, eg. the bolt head may be of square profile.

As seen in Figure 14, the tooth body 350 extends laterally beyond the main support beam 340 and is seated upon a support web 356 which projects from the beam 340.

Preferably the tooth body 350 further includes a pair of downwardly depending lugs 347 spaced apart by a distance corresponding to the width of the web 356 upon which it is seated. Accordingly, lugs 347 are located on opposite sides of the associated web 356 and co-operate therewith to restrain rotation of the tooth body 350.

Preferably each tooth body 350 is cast from a suitable metal.

Preferably the breaker bar body 301 is fabricated from steel sheet or bar.

Preferably, each side wall 16 is provided with openings 360 through which removable comb teeth 361 project. The comb teeth 361 project internally of the passageway 15 and inbetween adjacent ring assemblies 60 and serve to prevent larger lumps of material to be broken from passing between the side walls 16 and adjacent breaker drum assemblies 12.

CLAIMS

1. A mineral breaker including a pair of opposed end walls and a pair of opposed side walls which define a passageway for material to be broken, the opposed end walls and side walls being fixedly secured to one another to form a unitary housing, at least one rotatable breaker drum assembly extending across the passageway and being rotatably supported in said opposed end walls, said opposed end walls each having an elongate open mouthed slot for enabling insertion/removal of said drum assembly into/out of said unitary housing.

2. A mineral breaker according to Claim 1 wherein the open mouth of each slot is located adjacent to the top side of the respective end wall to enable the drum assembly to be lowered into or lifted out of said unitary housing.

3. A mineral breaker according to Claim 1 or 2 wherein the drum assembly includes a shaft, a first bearing assembly located adjacent to one end of the shaft and a second bearing assembly located adjacent to the other end of the shaft, the bearing assemblies being secured to said opposed end walls.

4. A mineral breaker according to Claim 3 wherein each end wall comprises a cavity wall structure having an inner wall facing said passageway, an outer wall facing the interior of the housing and at least one discharge cavity located therebetween, said bearing assemblies being mounted on the outer wall of respective end walls so as to be spaced from the inner wall such that material passing through the inner wall towards

the outer wall is able to discharge through said discharge cavity before reaching said bearing housing.

5. A mineral breaker according to any preceding claim including a pair of breaker drum assemblies located side by side to define therebetween a gap through which material to be broken is forced by said drum assemblies, and a breaker bar assembly mounted on said opposed end walls so as to extend parallel to and below said gap, the breaker bar co-operating with said breaker drum assemblies to further break down material passing through said gap.

6. A mineral breaker according to Claim 5 wherein the breaker bar is removably mounted on said opposed end walls.

7. A mineral breaker according to Claim 5 or 6 wherein the breaker bar is mounted so as to be height adjustable relative to said unitary housing to enable the spacing between the breaker bar and the drum assemblies to be adjusted.

8. A mineral breaker according to any preceding claim wherein the or each drum assembly includes a plurality of circumferentially extending groups of teeth spaced axially along the drum assembly, each group of teeth comprising at least 3 radially extending teeth.

9. A mineral breaker according to Claim 8 wherein two drum assemblies are provided with the circumferentially extending groups of teeth on one drum being located axially between the circumferentially extending teeth on the other drum, the teeth on each drum being arranged

to define a series of discrete helically extending deep troughs extending along each drum assembly.

10. A mineral breaker according to any preceding claim wherein the opposed side and end walls are formed from steel and are welded to one another to define said unitary housing.

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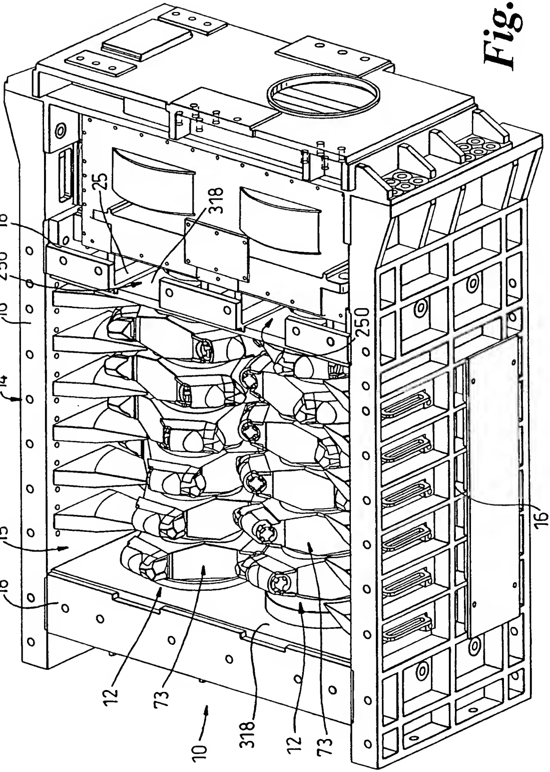
Fig. 1



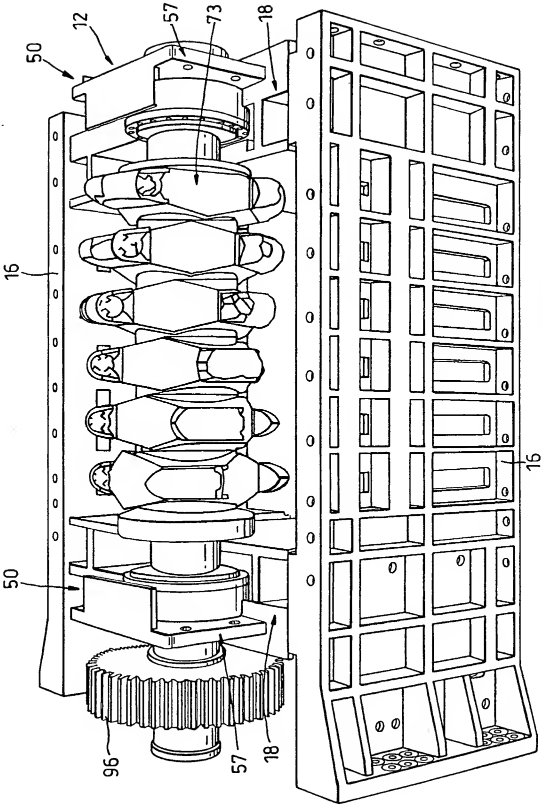


Fig. 2

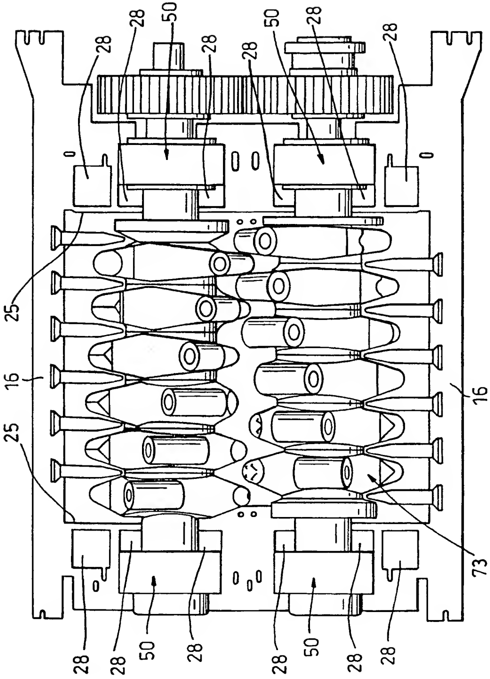


Fig. 3

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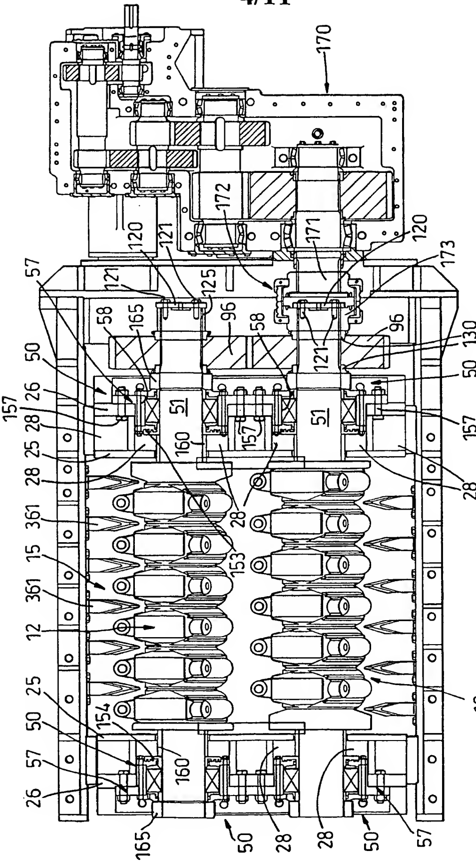
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Fig. 4

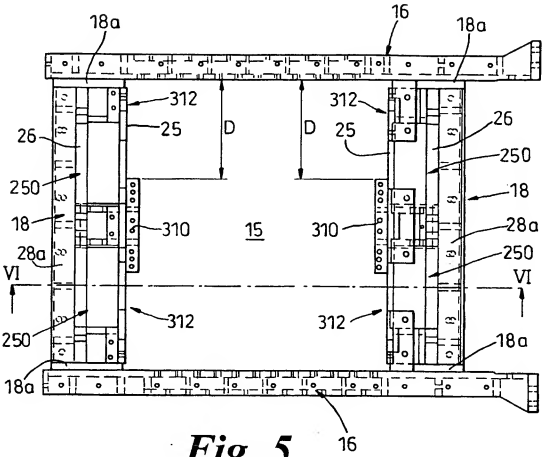
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Fig. 5

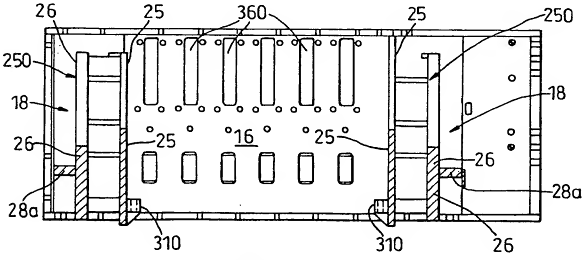
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Fig. 6

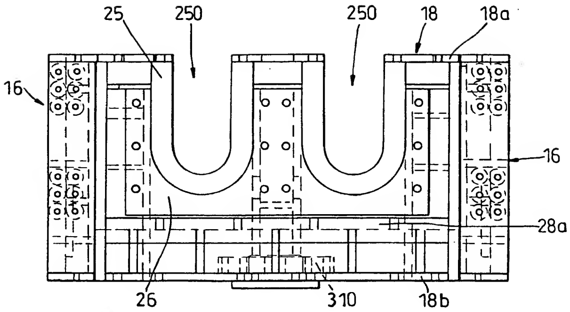

Fig. 7

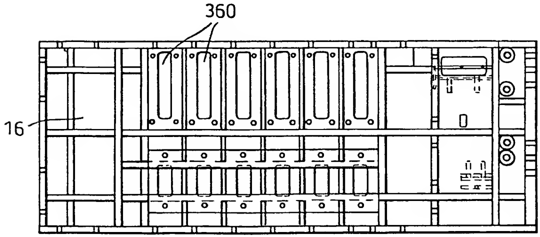

Fig. 8

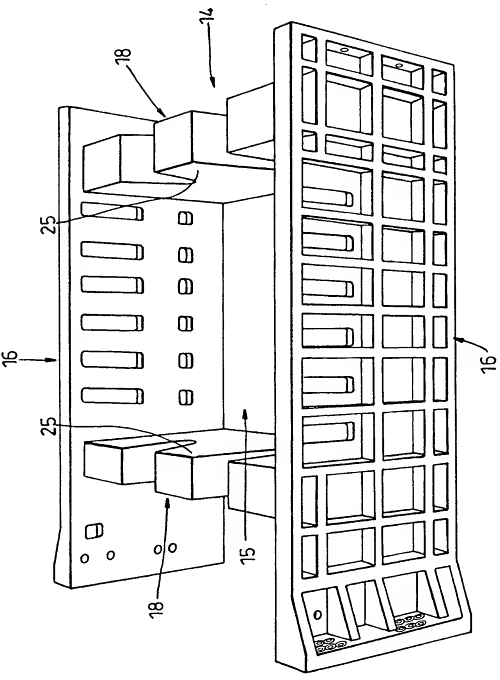

Fig. 9

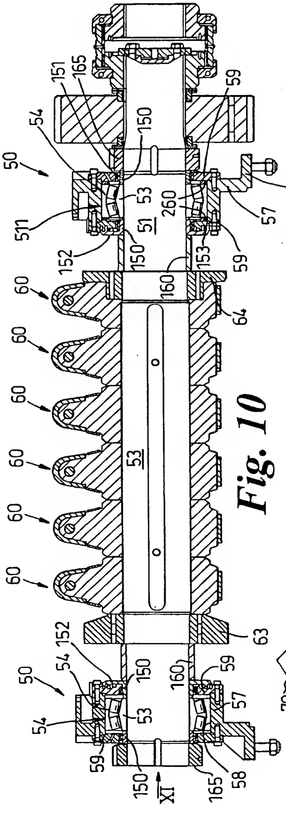

Fig. 10

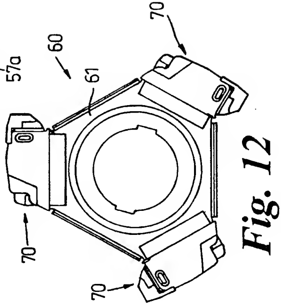

Fig. 12

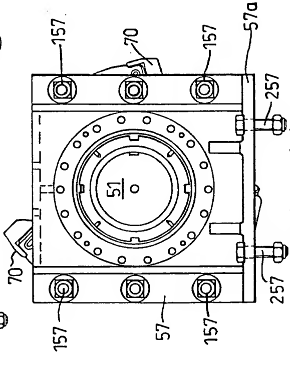

Fig. 11

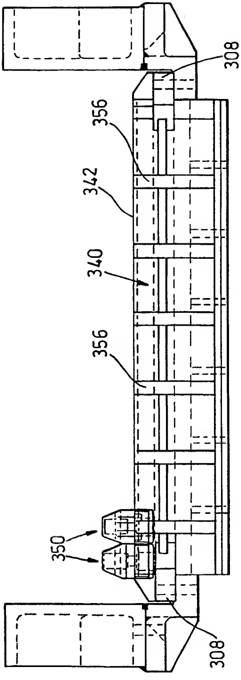
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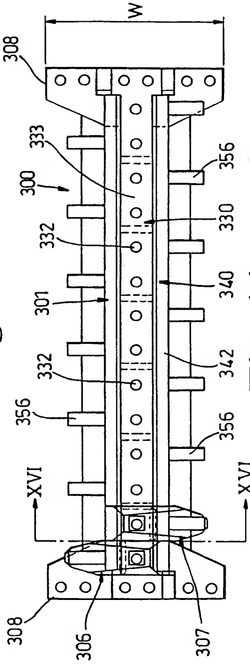
Fig. 13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XVI
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XVI
307

Fig. 14

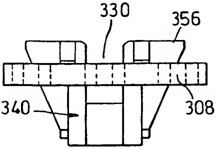


Fig. 15

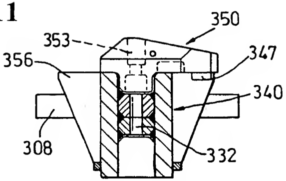


Fig. 16

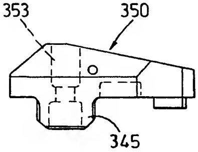


Fig. 17

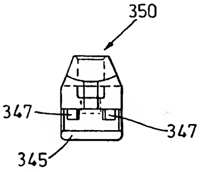


Fig. 18

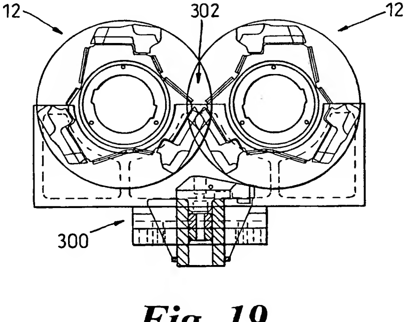
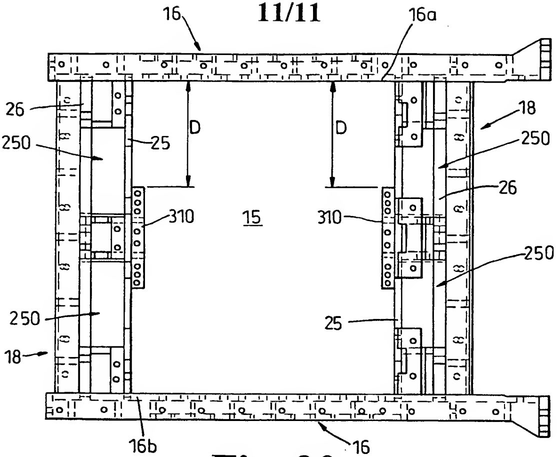


Fig. 19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18
16b
16

Fig. 20

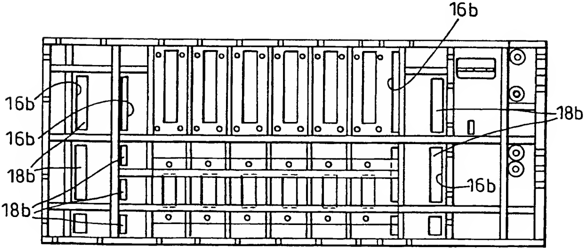
16b
16b
16b
18b
18b
18b
16b

Fig. 21

INTERNATIONAL SEARCH REPORT

Inte… …nal Application No
PCT/GB 99/04216

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B02C4/08 B02C4/28 B02C18/14 B02C18/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B02C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 667 187 A (PRECIMECA SOCIETE ANONYME) 16 August 1995 (1995-08-16) the whole document	1-3
Y		5-10
A		4
X	US 1 743 911 A (G.W. BORTON) 14 January 1930 (1930-01-14) claims 1-3; figures 1-3	1-3
Y		5-10
A		4
Y	EP 0 246 775 A (MMD DESIGN & CONSULT) 25 November 1987 (1987-11-25) column 1, line 47 -column 2, line 24; claim 1; figures 1-6	5-7

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 March 2000	03/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Verdonck, J

1

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/04216

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 4 799 627 A (POTTS ALAN) 24 January 1989 (1989-01-24) column 2, line 17 - line 49; figures 1-4	8-10

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/GB 99/04216

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